

WHAT IS CLAIMED IS:

1. An optical signal transmission device for transmitting phase information of optical signals comprising:

a multiplexing formatted optical signal generator arranged to generate multiplexing formatted optical signals; and

an optical phase generator arranged to receive the multiplexing formatted optical signals.

2. An optical signal transmission device as claimed in claim 1, wherein the bit rate of the multiplexing formatted optical signals is at least 80 Gbit/s.

3. An optical signal transmission device as claimed in claim 1, wherein the multiplexing formatted optical signal generator comprises an optical time division multiplexing (OTDM) carrier suppressed - return to zero (CS-RZ) signal generator arranged to generate OTDM-CS-RZ signals comprising signal light; and

wherein the optical phase generator comprises an optical phase conjugator arranged to receive the OTDM-CS-RZ signals from the OTDM CS-RZ signal generator.

4. An optical signal transmission device as claimed in claim 1, further comprising:

transmission fiber optically coupled to the optical phase generator, the transmission fiber arranged as a transmission route of the multiplexing formatted optical signals and comprising standard single mode fiber (SSMF).

5. An optical signal transmission device as claimed in claim 1, wherein said optical phase generator includes at least one semiconductor optical amplifier (SOA).

6. An optical signal transmission device as claimed in claim 5, wherein said at least one SOA comprises two or more SOAs.

7. An optical signal transmission device as claimed in claim 3, wherein said optical phase conjugator comprises:  
a continuous wave (CW) pump light source that emits pump light;  
a pump light amplifier arranged to amplify the pump light emitted by the CW pump light source;  
a first phase conjugator arranged to arrange the phase of the signal light;  
a signal light amplifier arranged to amplify the signal light;  
a second phase conjugator arranged to arrange the phase of the signal light;  
an optical coupler arranged to couple the signal light and the pump light from the first phase conjugator and the second phase conjugator and emit the coupled light;  
a first and a second semiconductor amplifier (SOA) arranged to amplify the coupled light and provide phase conjugated light; and  
a light filter arranged to filter the phase conjugated light from the second SOA.

8. An optical signal transmission device as claimed in claim 1, wherein said multiplexing formatted optical signal generator comprises:

a first optical coupler arranged to divide a received signal evenly at a rate of 1:1 into a first portion and a second portion;

a first phase shifter arranged to receive the first portion and to arrange the phase of the first portion;

a second phase shifter arranged to receive the second portion and to arrange the phase of the second portion;

a second optical coupler arranged to couple the light emitted by the first phase shifter with the light emitted by the second phase shifter and emit a first coupled signal;

a third optical coupler arranged to divide the first coupled signal evenly at a rate of 1:1 into a third portion and a fourth portion;

a third phase shifter arranged to receive the third portion and to arrange the phase of the third portion;

a fourth phase shifter arranged to receive the fourth portion and to arrange the phase of the fourth portion; and

a fourth optical coupler arranged to couple the light emitted by the third phase shifter with the light emitted by the fourth phase shifter and emit a second coupled signal.

9. An optical signal transmission device as claimed in claim 8, further comprising:

a fifth optical coupler arranged to divide the second coupled signal evenly at a rate of 1:1 into a fifth portion and a sixth portion;

a fifth phase shifter arranged to receive the fifth portion and to arrange the phase of the fifth portion;

a sixth phase shifter arranged to receive the sixth portion and to arrange the phase of the sixth portion; and

a sixth optical coupler arranged to couple the light emitted by the fifth phase shifter with the light emitted by the sixth phase shifter and emit a third coupled signal.

10. An optical signal transmission device as claimed in claim 1, further comprising:

a first transmission route comprising standard single mode fiber (SSMF) between the multiplexing formatted optical signal generator and the optical phase generator; and

a second transmission route arranged after the optical phase generator, wherein both the first transmission route and the second transmission route are longer than 100 km.

11. An optical information transmission method for transmitting optical signal information including phase information comprising:

receiving multiplexing formatted optical signals generated by a multiplexing formatted optical signal generator at an optical phase generator; and

phase conjugating the multiplexing formatted optical signals by means of four wave mixing (FWM).

12. An optical information transmission method as claimed in claim 11, wherein the multiplexing formatted optical signals comprise optical time division multiplexing carrier suppressed - return to zero (OTDM-CS-RZ) signals.

13. An optical information transmission method as claimed in claim 11, further comprising:

transmitting the multiplexing formatted optical signals through a first transmission route before the phase conjugating step; and

transmitting the multiplexing formatted optical signals through a second transmission route after the phase conjugating step.

14. An optical information transmission method as claimed in claim 13, wherein both the first transmission route and the second

transmission route comprise standard single mode fiber (SSMF) with a length greater than 100 km.

15. An optical information transmission method as claimed in claim 11, wherein the phase conjugating step further comprises:

emitting continuous wave (CW) pump light;

arranging the phase of signal light of the multiplexing formatted optical signals;

coupling the signal light having a conjugated phase and the pump light to provide coupled light;

performing a first amplification of the coupled light to provide first amplified light; and

amplifying the first amplified light to provide phase conjugated light.

16. An optical information transmission method as claimed in claim 15, wherein the phase conjugating step further comprises:

filtering the phase conjugated light.

17. An optical information transmission method as claimed in claim 11, wherein the phase conjugating step further comprises:

emitting continuous wave (CW) pump light;

arranging the phase of the signal light of the multiplexing formatted optical signals; and

coupling the signal light having an arranged phase and the pump light to provide coupled light.

18. An optical information transmission method as claimed in claim 11, further comprising:

generating the multiplexing formatted optical signals using the multiplexing formatted optical signal generator.

19. An optical information transmission method as claimed in claim 18, wherein the generating the multiplexing formatted optical signals comprises:

- dividing a received signal evenly at a rate of 1:1 into a first portion and a second portion;

- arranging the phase of the first portion;

- arranging the phase of the second portion;

- coupling the first portion having a conjugated phase and the second portion having a conjugated phase to provide a first coupled signal;

- dividing the first coupled signal evenly at a rate of 1:1 into a third portion and a fourth portion;

- arranging the phase of the third portion;

- arranging the phase of the fourth portion; and

- coupling the third portion having a conjugated phase and the fourth portion having a conjugated phase to provide a second coupled signal.

20. An optical information transmission method in claim 19, wherein the generating the multiplexing formatted optical signals further comprises:

- dividing the second coupled signal evenly at a rate of 1:1 into a fifth portion and a sixth portion;

- arranging the phase of the fifth portion;

- arranging the phase of the sixth portion; and

- coupling the fifth portion having an arranged phase and the sixth portion having an arranged phase to provide a third coupled signal.

21. An optical signal transmission device comprising:

an optical time division multiplexing (OTDM) carrier suppressed - return to zero (CS-RZ) signal generating means for generating OTDM-CS-RZ signals comprising signal light; and

an optical phase conjugating means for receiving the OTDM signals from the OTDM-CS-RZ signal generating means.